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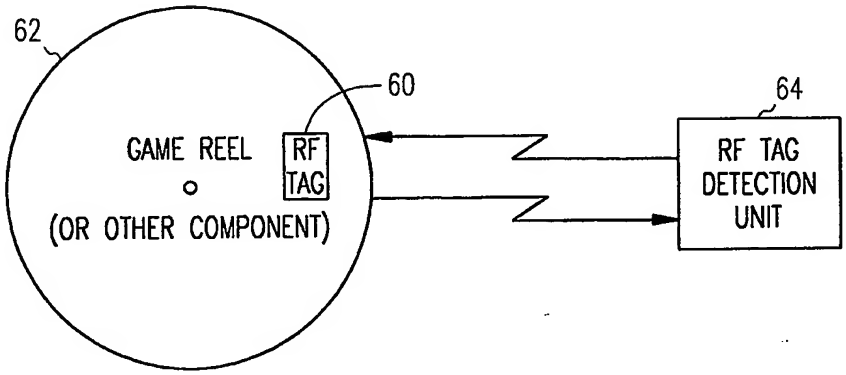
(54) Title: IDENTIFYING COMPONENTS OF A CASINO GAME



(57) Abstract: This application describes, among other things, a casino game for use in a gaming establishment wherein at least some of the components of the game include an attached radio frequency-responsive element, such as an RFID tag. In one example, the radio frequency-responsive element contains information regarding the corresponding attached components. In another example, the casino game contains a plurality of selected components having RFID tags. When the tags are interrogated, information provided by the tags can be used to determine whether components of the game have been replaced, are missing, or the like. Also, a method of identifying components in the game is disclosed. In one example, the method includes interrogating radio frequency-responsive elements attached to selected components of the casino game, receiving a response code signal from the interrogated radio frequency-responsive elements, and generating an output based on the received signals.

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IDENTIFYING COMPONENTS OF A CASINO GAME

Cross Reference To Related Applications

This application claims the benefit of U.S. Provisional Application Serial No. 60/564,321 filed April 22, 2004, which is incorporated herein by reference.

Technical Field of the Invention

The present invention pertains generally to casino gaming apparatus, or casino games; and more particularly to articles, apparatus and methods for identifying selected components of casino games suitable for use in a gaming establishment.

Copyright

Background of the Invention

The security and reliability of gaming devices is of foremost importance to gaming regulators and to game manufacturers. As such, it is very important that the components of gaming machines and devices be maintained in working order and also that the proper components are indeed used in any particular game. Described below are various embodiments of the inventive subject matter disclosed herein hereof that may, among other things, assist in improving the security and reliability of gaming devices.

Brief Description of the Drawings

Figures 1A, 1B, 2 and 3 illustrate various system embodiments of the disclosed inventive subject matter.

Figures 4 and 5 illustrate various method embodiments of the disclosed inventive subject matter.

Figure 6 illustrates an example embodiment of the disclosed inventive subject matter.

Detailed Description of the Inventive Subject Matter Disclosed Herein

In the following detailed description of the embodiments of the inventive subject matter disclosed herein, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific embodiments in which the inventive subject matter disclosed herein may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the inventive subject matter disclosed herein, and it is to be understood that other embodiments may be utilized and that changes may be made without departing from the scope of the present inventive subject matter. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present inventive subject matter is defined only by the appended claims.

As used herein, the term casino game encompasses, without limitation, slot machines, video poker machines, roulette tables, poker tables, craps tables and any other game of chance offered by a gaming establishment wherein for example the game qualifies as regulated and/or licensed gaming equipment. The term gaming establishment refers to an establishment that offers casino gaming experiences to its patrons and, in one example embodiment, is licensed by a gaming regulatory authority to provide such gaming experiences.

Figures 1A and 1B illustrate one example embodiment of the inventive subject matter disclosed herein, located at an example gaming establishment 10. The gaming establishment 10 includes at least one but often a plurality of casino games 12. Each casino game 12 in the example includes a plurality of subcomponents, and one or more of the subcomponents includes an attached

radio frequency-responsive element 14a, 14b, ... 14n. In the example, a person using a reader device 16 can interrogate the radio frequency-responsive elements of each casino game 12 using radio frequency identification. The interrogation process may be used to develop an inventory of the game components. This inventory can be recorded and analyzed manually or automatically to determine if the detected components are as expected based on preexisting records or other factors. It may thus be determined if the casino game has or at least appears to contain the expected or correct components or whether the casino game includes additional, fewer or unanticipated components. The inventory of the machine may also be used for other purposes such as ordering or identifying a replacement part. The system of the present disclosure thus incorporates radio frequency identification to create a more secure casino game or gaming establishment by allowing rapid verification that casino games contain the desired or expected components, and that improper or uncertified components are not improperly installed or swapped between machines.

Radio frequency identification, or RFID, is a term for technologies that use radio waves and radio frequency-responsive elements to automatically identify individual items. One of the most common methods of identifying individual items is to store a serial number that identifies a component, and perhaps other information, on a radio frequency-responsive element. One example of a radio frequency-responsive element is a microchip that is attached to an antenna, described in more detail below with respect to Figure 2. The chip and the antenna together are often called an RFID transponder or an RFID tag. The antenna enables the chip to transmit the identification information to a reader. A reader converts the radio waves returned from the radio frequency-responsive element into a form that can then be passed on to, for example, a software system that can make use of it.

Radio frequency-responsive elements can be either active or passive. An active tag incorporates an additional energy source, such as a battery, into the tag construction. This energy source permits active radio frequency-responsive elements to create and transmit strong response signals even in regions where the interrogating radio frequency field is weak, and thus an active radio frequency-responsive element can be detected at greater range. However, the relatively short lifetime of the battery limits the useful life of the tag. In addition, the

battery adds to the size and cost of the tag. A passive element derives the energy needed to power the element from the interrogating radio frequency field, and uses that energy to transmit response codes by modulating the impedance the antenna presents to the interrogating field, thereby modulating the signal reflected back to the reader antenna. Thus, their range is more limited. Because passive elements are preferred for many applications, the remainder of the discussion will be confined to this class of element. Those skilled in the art, however, will recognize that these two types of elements share many features and that both can be used in the examples of this disclosure.

Figure 1B shows a casino game 12 including a plurality of radio frequency-responsive elements 14a-14n that are associated with respective subcomponents of the casino game 12. By way of illustration, components of the casino games 12 can include items such as the housing, monitors, printers, hoppers, money validation devices, cabinets, secondary displays, dot matrix devices, signage, chairs, power supplies, lights, electronic boards, or other components such as Flash memory, read-only memory (ROM) or programmable read only memory devices (PROM) devices or other data storage devices, or processing units. The ROM, PROM or other memory storage devices may store critical and sensitive software or data used to control machine operation, calculate odds, determine payouts or other sensitive computations or controls. Those skilled in the art can recognize that this list is not inclusive or applicable to each casino game covered by the inventive subject matter disclosed herein. In one example, the elements are attached to the subcomponents with a pressure sensitive adhesive (PSA). An example of information stored in each element and transmitted to a reader interrogating the element can include an identification of the attached component.

Additional security is obtained by making the RFID tag tamper-evident, tamper-resistant, or tamper-proof. One way of providing such additional security is to use high strength adhesive to attach the RFID tag to the subcomponents of the machine, for example by adhering the antenna of the radio frequency-responsive element to the component such that removal of the RFID tag would destroy or disable the antenna. In another example, the RFID tag may be permanently, semi-permanently or removably attached to the component using tamper-resistant, tamper-evident or tamper proof fastening, or by other

means. Such fastening may include riveting or molding the RFID tag to the subcomponents of the machine. In cases where the RFID tags are readily visible to an observer, additional security measures can include other coded or uncoded visual information on the RFID tag.

As shown in FIG. 2, a passive radio frequency-responsive element 14 typically includes two components: an integrated circuit 22 and an antenna 24. The integrated circuit provides the primary identification function. It includes software and circuitry to permanently store the tag identification and other desirable information, interpret and process commands received from the interrogation hardware, respond to requests for information by the interrogator, and assist the hardware in resolving conflicts resulting from multiple tags responding to interrogation simultaneously. Optionally, the integrated circuit may provide for updating the information stored in its memory (read/write) as opposed to just reading the information out (read only). Integrated circuits suitable for use in radio frequency-responsive elements include those available from Texas Instruments (in their TIRIS line of products), Philips (in their Mifare and Hitag line of products), Motorola/Indala, and Single Chip Systems, among others. One example is a tag from Texas Instruments sold under the trade designation #RI-I01-110A.

The antenna geometry and properties depend on the desired operating frequency of the radio frequency-responsive portion of the tag. For example, 2.45 GHz (or similar) radio frequency-responsive elements would typically include a dipole antenna, such as the linear dipole antennas (not shown), or folded dipole antennas (not shown). A 13.56 MHz (or similar) radio frequency-responsive element would use a spiral or coil antenna 24. In either ease, the antenna 24 intercepts the radio frequency energy radiated by an interrogation source. This signal energy carries both power and commands to the tag. The antenna enables the radio frequency-responsive element to absorb energy sufficient to power the IC chip and thereby provide the response to be detected. Thus, the characteristics of the antenna must be matched to the system in which it is incorporated. In the case of tags operating in the high MHz to GHz range, an important characteristic is the antenna length. Typically, the effective length of a dipole antenna is selected so that it is close to a half wavelength or multiple half wavelength of the interrogation signal. In the case of tags operating in the

low to mid MHz region (13.56 MHz, for example) where a half wavelength antenna is impractical due to size limitations, the important characteristics are antenna inductance and the number of turns on the antenna coil. For both antenna types, good electrical conductivity is required. Typically, metals such as copper or aluminum would be used, but other conductors, including magnetic metals such as permalloy, are also acceptable. It is also important that the input impedance of the selected IC chip match the impedance of the antenna for maximum energy transfer.

A capacitor 26 is often included to increase the performance of the marker. The capacitor 26, when present, tunes the operating frequency of the tag to a particular value. This is desirable for obtaining maximum operating range and insuring compliance with regulatory requirements. The capacitor may either be a discrete component, or integrated into the antenna as described below. In some tag designs, particularly tags designed to operate at very high frequencies, such as 2.45 GHz, a tuning capacitor is not required. The capacitor is selected so that, when coupled to the inductance provided by the antenna, the resonant frequency of the composite structure, given by:

$$f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$$

where C=capacitance (in Farads) and L=inductance (in Henries), closely matches the desired operating frequency of the RFID system. The capacitor may also be a distributed capacitor as described in U.S. Patent Nos. 4,598,276 to Tait et al. and 4,578,654 to Tait et al. Distributed capacitance is desirable to reduce tag size, particularly thickness, and to minimize manual assembly.

In operation, as shown in FIG. 3, the radio frequency-responsive element 14 is interrogated by reader system 30, which is typically located near the point at which the tags are to be monitored. Hand held detection devices such as reader device 16 shown in Figure 1B may be used. An interrogation source 32 (typically including a drive oscillator and an amplifier) is coupled to an antenna 34 (sometimes described as a field coil) for transmitting an alternating radio frequency field, or interrogation signal, in the interrogation zone. The system 30 also includes an antenna for receiving a signal (shown as antenna 34, and

sometimes described as a receiving coil) and detector 36 for processing signals produced by tags in the interrogation zone.

The interrogation source 32 transmits an interrogation signal 37a, which may be selected within certain known frequency bands that are preferred because they do not interfere with other applications, and because they comply with applicable government regulations. When the radio frequency-responsive element receives an interrogation signal it transmits its own response code signal 37b that is received by the antenna 34 and transmitted to detector 36. The detector decodes the response, identifies the tag (typically based on information stored in a computer and/or other memory device 38), and takes action based on the code signal detected. Various modifications of the illustrated system are known to those of skill in the art including, for example, using separate antennas for the interrogation source 32 and the detector 36 in place of the single antenna 34 that is illustrated.

A computer system 31 is further provided in one example embodiment in order to store and analyze machine inventory data. System 31 may be located proximate the gaming machines 12, or may be located remotely from the machines, or may be portable, for example carried by maintenance or security worker. System 31, in one embodiment, may store an inventory of subcomponents for each machine. Such inventory may be input in the system 18 manually, or may be input automatically for example by scanning a machine after it has been assembled and automatically gathering the inventory information from the results of the scan. System 31, in one embodiment, includes software 33 capable of assembling and maintaining the inventory, retrieving inventory data and modifying inventory data representing the subcomponents of a machine. In one embodiment, system 31 is a server that is accessible to personnel responsible for assembling and shipping machines 12. System 31 may also be accessible to maintenance or security personnel working in a casino environment in which the machines 12 are positioned. Such as server may be an Internet-based server, for example a web server, or any other type of server or method for wide area network access, for example using wireless communications.

Further, software 33 may further be capable of storing and retrieving warranty information in association with each subcomponents and an associated

RF tag. Such software may permit a technician working on or checking a machine 12 to look up pertinent warranty or repair information, based on the identification of the component using the RFID tag.

Radio frequency identification of the subcomponents does not require line of sight (LOS). Radio frequency-responsive elements 14 can be read as long as they are within range of a reader. Radio waves travel through most non-metallic materials, allowing radio frequency-responsive elements or the readers to be embedded in packaging or encased in protective plastic for weather-proofing and greater durability. Reading an RFID through a metallic barrier can be often difficult, and many elements tend to detune when placed proximate to metallic devices. The casino game can be provided with a removable panel 19, or the like, that can create an opening to make the elements 14a-14n more readable. The panel 19 can be removed and the reader inserted into or placed proximate the opening in order to better read radio-obscured elements. Also, elements that are attached to metallic components or components containing metallic parts can be spaced apart from the metal. Many elements are prone to detune unless spaced apart from metal by at least about one-quarter of an inch (6.4 mm). The elements can be strategically placed to be at least one-quarter inch from metallic parts. In the case of elements attached to metallic components, the elements can be spaced apart from the component by including a spacer, such as a polyurethane foam pad, between the surface of the component and the element.

Additionally, most radio frequency identification technologies permit readers to interrogate several elements at once. Elements within the range of a reader can be interrogated with a single interrogation signal. Tag collision occurs when more than one element reflects back a signal at the same time, confusing the reader. Different vendors of RFID technology have developed different systems for having the tags respond to the reader one at a time. Because they can be read in milliseconds, it appears that all the tags are being read simultaneously. The reader can receive information from several elements based on this interrogation signal, and the reader can distinguish information received from each of the elements. Readers can be constructed such that an entire casino game is within an interrogation zone so as to receive response code signals from each of the elements with a single interrogation signal.

Information provided to the reader with each received response code signal can be processed in one or more of several ways. For example, a handheld reader may be completely self-contained in that it can store and process the received signals and provide an output for a user. Other types of readers can provide a signal to another system that would then create an output for the user. For example, information received from a reader can be uploaded into a computer network that can then store and process the uploaded information and provide a usable output.

The casino game 12 can be used in one or more interrogation strategies. A basic interrogation strategy is illustrated in Figure 4. In general, interrogation strategy 40 includes interrogating the radio frequency-responsive elements attached to the subcomponents 42, receiving a response code signal from the interrogated elements 44, and generating an output based on the received signals 46. One species of the interrogation strategy 40 is shown in Figure 5 as strategy 50 and includes creating a reference data 52, interrogating the radio frequency-responsive elements attached to the subcomponents 42, receiving a response code signal from the interrogated elements 44, comparing information in the received signals to the reference data 54, and generating results of the comparison 56.

Many applications of the interrogation strategies are contemplated. Among these applications is the ability to determine whether a casino game has missing or improperly swapped or replaced parts. For example, the casino game includes subcomponents with matching RFID tags. The tags can be interrogated and read. The relevant information from the response code signals is processed to determine whether the detected RFID tags match those stored in the inventory database for the machine. If so, it can be inferred that the subcomponents have not been replaced. Additional information can be included in the response code signal to identify which component corresponds with the tag. This information from the response code signals can be processed to determine whether all of the subcomponents included during manufacture are still in the machine. This interrogation can also determine if certain other components (with attached RFID tags) are included in addition to those included in manufacture. In another example embodiment as referred to above with respect to system 18, the tags of each game may be read at manufacture and the information stored in an

electronic file so that serial numbers or other identification codes can be associated with a particular casino game. Later, the tags can be interrogated and the information in the response code signals compared to the electronic file. If there are no discrepancies, it can be inferred that the subcomponents of the casino game have not been replaced or removed. Many algorithms and processes can be developed to implement these and similar interrogation strategies, including algorithms and processes to verify that part removal or part replacement has been authorized, and are intended to be included within the scope of the inventive subject matter disclosed herein.

The interrogation strategies can be used to verify the authenticity of a casino game or to determine whether the game has been tampered with. Examples of these are described here briefly. An agent of the manufacturer or gaming establishment may want to verify that parts have not been removed or replaced during shipment of the game between intended destinations. Also, the gaming establishments or gaming regulators might want to verify that certain critical components have not been removed or tampered with. Through the application and use of the inventive subject matter disclosed herein

Another example involves warranty issues. Casino games in gaming establishments often are sold with a manufacturer's limited warranty. The warranty often expires after a predetermined period of time. The gaming establishment may own or otherwise possess several of the same games, some of which may include expired warranties. In one example, a specific component fails in one game no longer covered by warranty. Some repair technicians have been known to swap the failed component and replace it with a like component obtained from an otherwise working game that is still covered by warranty. The failed part may then be presented for warranty repair contrary to the interests of the manufacturer.

Applications of the inventive subject matter disclosed herein can also include tracking individual subcomponents, or tracking several similar subcomponents. RFID tags on subcomponents may also be used to track the selected component through manufacturing, for example. RFID tags can also be used to track inventories of subcomponents. One example is that an entire palette of a particular selected component can be interrogated at once to determine, based on the received response code signals, the exact number of

subcomponents on that pallet. Other applications can be readily imagined. In addition, in another embodiment, RF interrogation is used to track the movement of casino gaming components in a manufacturing or warehouse facility in order to prevent unauthorized removal of such components and/or potential tampering with such components.

According to still another example embodiment according to the inventive subject matter herein, there is provided a method for ensuring regulatory compliance of casino games by tagging casino game components with RF tags, and using RF tag interrogation to collect data on the components in the games in operation in a casino, and to verify that such components are consistent with components expected to be in such games. Using this method, regulators may assure themselves that bona-fide, authentic casino game equipment is being used by a casino or other gaming operator.

According to still another example embodiment schematically illustrate in Figure 6, an RF tag 60 is affixed or mounted on a reel 62 of a casino game, and used to determine the position of the reel as it spins, by detection of the RF tag by a detection unit 64 that interrogates the tag 60 and detects its proximity. Other casino game components such as dice or roulette wheels or dice or roulette balls may be equipped with RF tags and detected so as to ascertain their position and/or authenticity during the play of the game, again using a detection unit that is positioned so as to be able to detect the RF tag associated with the component.

There is described above a number of embodiments of inventive subject matter wherein RFID tags are used to identify subcomponents of a casino game.

Claims

We claim:

1. Apparatus comprising:
a casino game having one or more subcomponents wherein at least one of the subcomponents includes a radio frequency-responsive element that can be used to identify the component.

2. Apparatus according to claim 1 further wherein the radio frequency-responsive element includes an antenna and an integrated circuit, the radio frequency-responsive element having information storage and transmission capabilities adapted to enable an interrogation system to obtain information from the radio frequency-responsive element.

3. Apparatus according to claim 1, wherein the information stored in the radio frequency-responsive element is related to identification of the component of the casino game.

4. Apparatus according to claim 1 wherein at least a portion of the radio frequency-responsive element is physically attached to the component.

5. Apparatus comprising:
a casino game including a plurality of components wherein at least one of the selected components includes a radio frequency-responsive element including an antenna and an integrated circuit, the radio frequency-responsive element having information storage and transmission capabilities adapted to enable an interrogation system to obtain information from the radio frequency-responsive element;
wherein the information stored in each of the radio frequency-responsive elements is related to the attached component.

6. The casino game of claim 5, wherein the information provided from the radio frequency-responsive elements is interpreted to determine the identity of the at least one component.

7. The casino game of claim 5, wherein the information provided from the radio frequency-responsive elements is interpreted to determine whether the component is the component expected to be present in the game.

8. The casino game of claim 5 and further comprising a removable panel adapted to permit interrogation of all of the selected components in the casino game.

9. A method comprising:
interrogating radio frequency-responsive elements associated with one or more components of the casino game;
receiving a signal from the interrogated radio frequency-responsive elements; and
recording information about the components based on the received signals.

10. A method according to claim 9, and further comprising:
creating reference data related to the casino game;
comparing information from the received signals to the reference data; and
generating results of the comparison.

11. A method according to claim 9 further including interrogating the components while they are in an assembled casino game.

12. A method comprising:
assembling a casino game;
interrogating radio frequency-responsive elements associated with one or more components of the casino game while the components are in the assembled game;
receiving a signal from the interrogated radio frequency-responsive elements; and
recording information about the components based on the received signals.

13. A method according to claim 12, and further including creating reference data related to the casino game, comparing information from the received signals to the reference data, and generating results of the comparison.

14. A method comprising:

obtaining a component to be assembled in a casino game;

positioning a radio-frequency responsive element with the casino game component; and

assembling the component into a casino game.

15. A method according to claim 14 further including interrogating the component after it has been assembled in the casino game.

16. A method according to claim 14 further including creating a reference database indicating components known to be present in the casino game based on the interrogation.

17. A method comprising affixing the radio-frequency responsive element to the game component using one or more of the following: adhesives, mechanical fasteners, integrated molding.

18. A method according to claim 17 further including making the affixed component one or more of the following: tamper-evident, tamper resistant or tamper proof.

19. A method comprising:

obtaining a casino game component;

using a radio-frequency responsive element to tag the component; and

detecting the casino game component in a manufacturing facility by interrogating the radio-frequency responsive element.

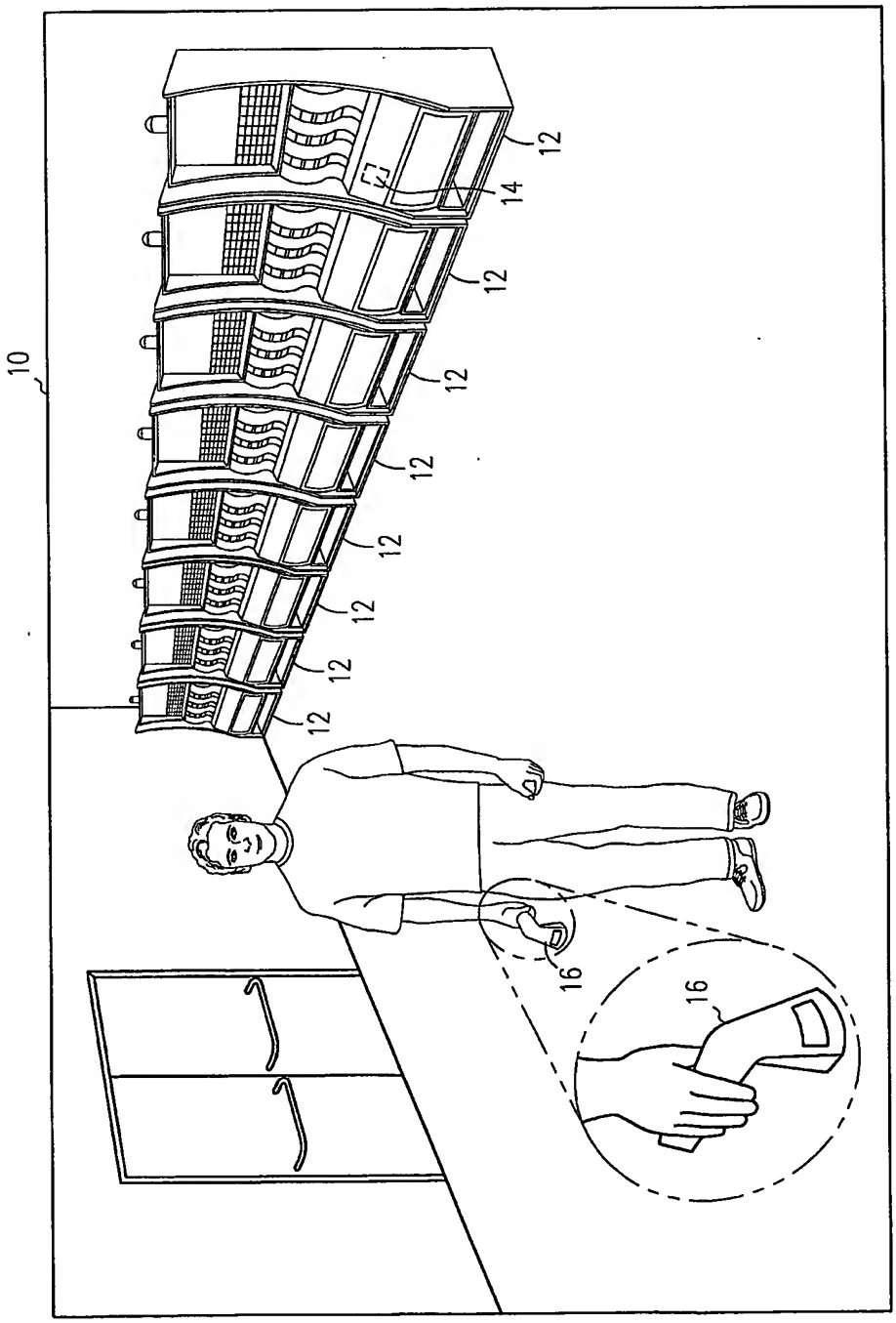

FIG. 1A

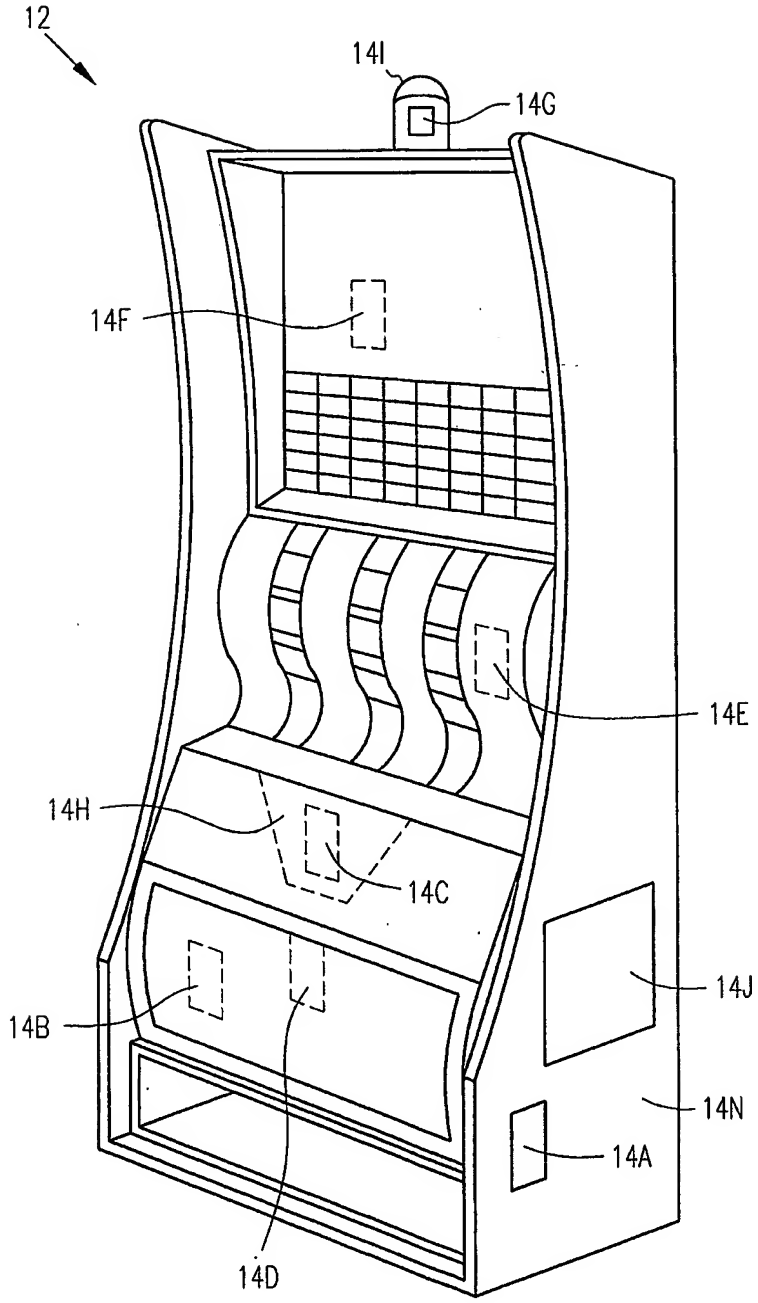

FIG. 1B

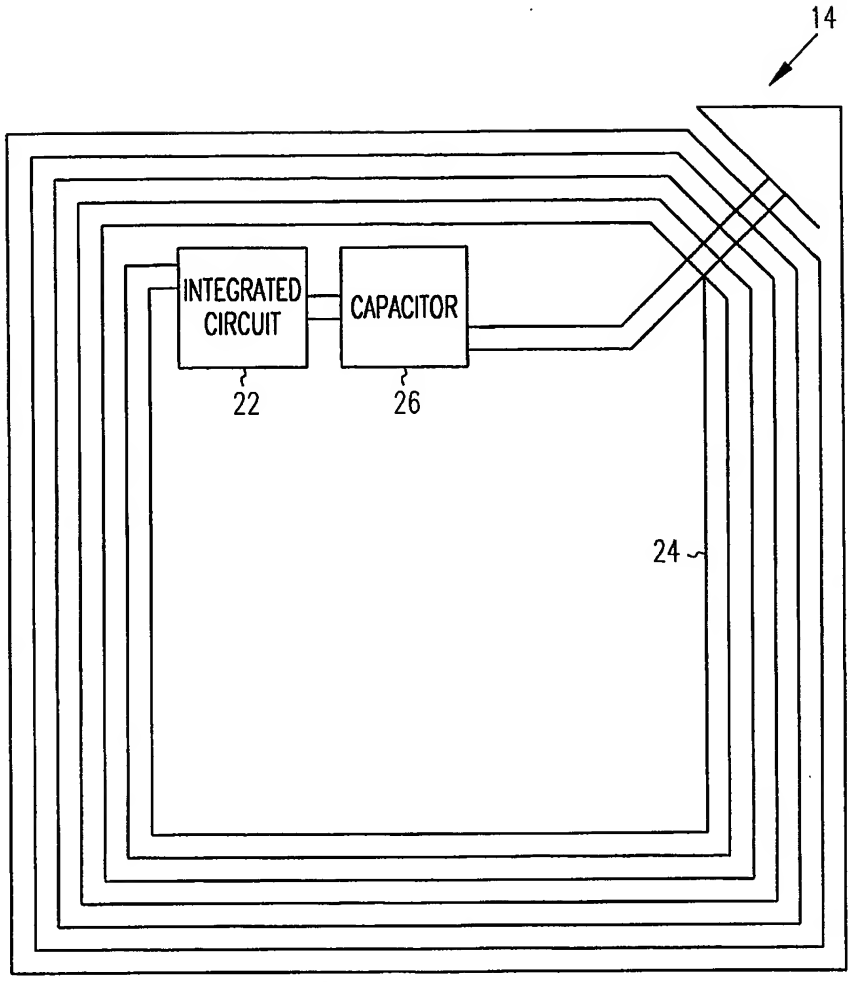

FIG. 2

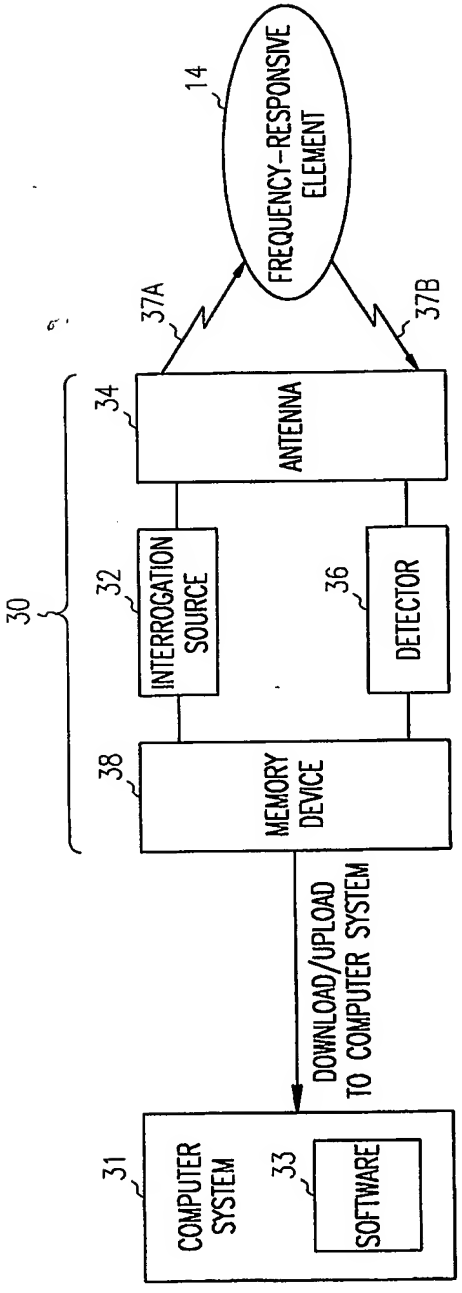
FREQUENCY-RESPONSIVE ELEMENT
14
37A
37B
ANTENNA
34
INTERROGATION SOURCE
32
DETECTOR
36
30
MEMORY DEVICE
38
DOWNLOAD/UPLOAD TO COMPUTER SYSTEM
COMPUTER SYSTEM
31
SOFTWARE
33

FIG. 3

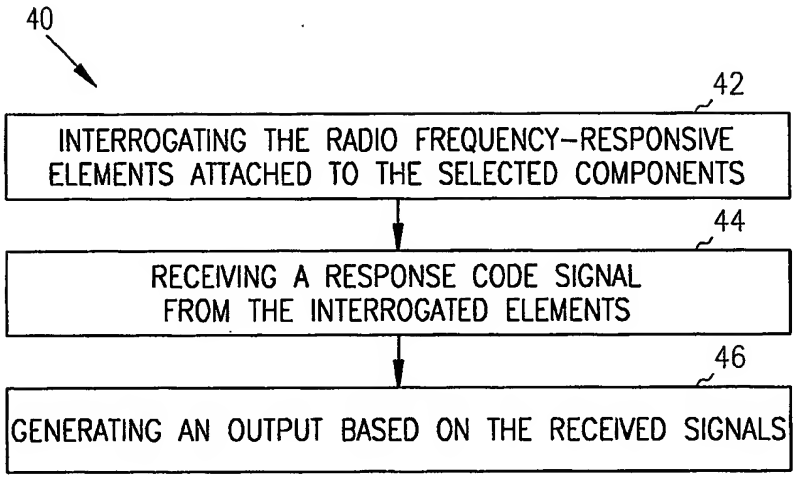
40
42
INTERROGATING THE RADIO FREQUENCY-RESPONSIVE ELEMENTS ATTACHED TO THE SELECTED COMPONENTS
44
RECEIVING A RESPONSE CODE SIGNAL FROM THE INTERROGATED ELEMENTS
46
GENERATING AN OUTPUT BASED ON THE RECEIVED SIGNALS

FIG. 4

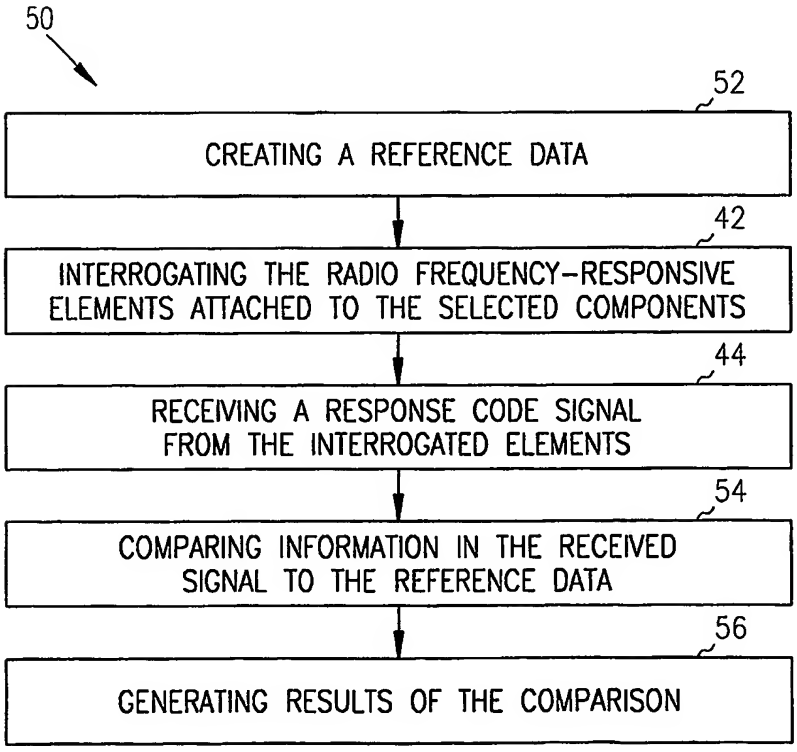
50
52
CREATING A REFERENCE DATA
42
INTERROGATING THE RADIO FREQUENCY-RESPONSIVE ELEMENTS ATTACHED TO THE SELECTED COMPONENTS
44
RECEIVING A RESPONSE CODE SIGNAL FROM THE INTERROGATED ELEMENTS
54
COMPARING INFORMATION IN THE RECEIVED SIGNAL TO THE REFERENCE DATA
56
GENERATING RESULTS OF THE COMPARISON

FIG. 5

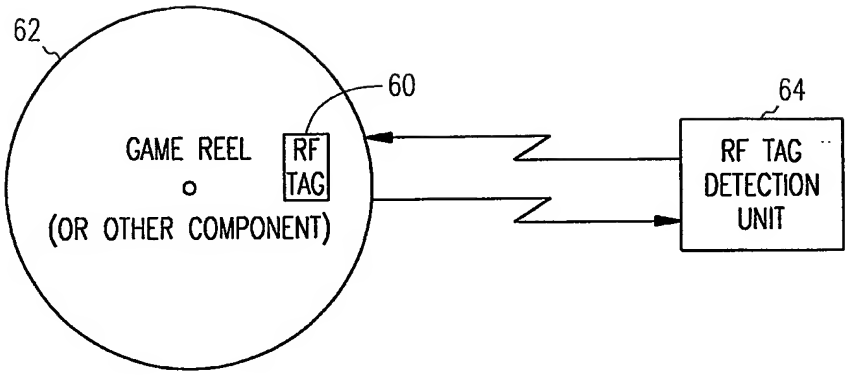
62
60
64
GAME REEL
RF TAG
(OR OTHER COMPONENT)
RF TAG DETECTION UNIT

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/13514

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : A63F 9/24
US CL : 463/1,16,29; 273/237
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 463/1,16,29; 273/237

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
USPAT, USPGPUB, EPO, JPO. Terms RFID, Chip, wager, bet, gamble.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,651,548 A1 (FRENCH et al) 29 July 1997 (29.07.1997), Abstract, Col 1:20-25, Col 1:59-2-:31, Col 4:40-53.	1-7, 9-18 --- 8, 19

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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